OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Demande-Application**

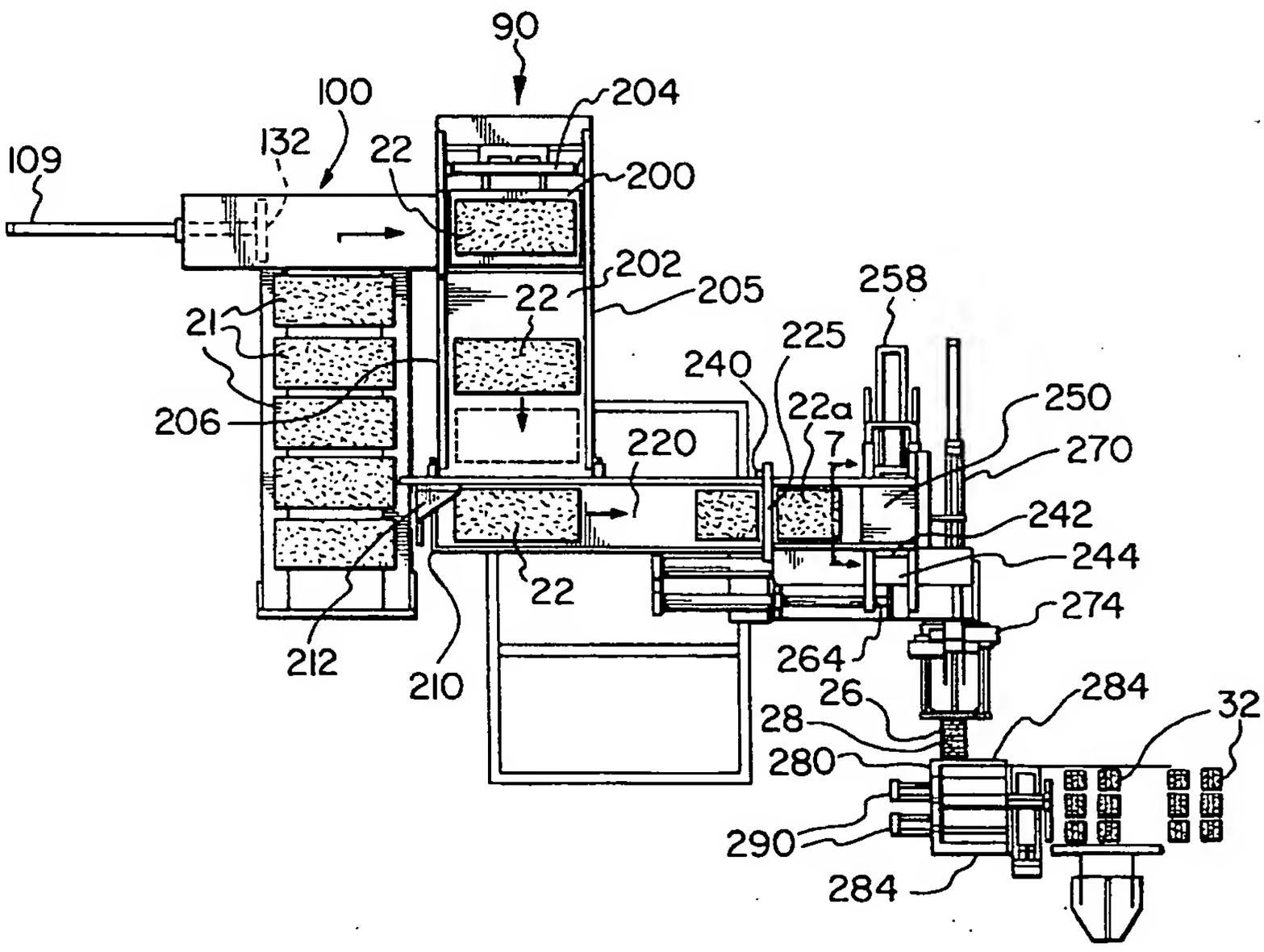
(21) (A1) **2,282,838**
(22) 1999/09/20
(43) 2000/05/02

(72) VAN HIERDEN, ED, CA
(71) VAN HIERDEN, ED, CA

(51) Int.Cl.[6] A01F 29/00, A01F 29/08, A01F 15/00
(30) 1998/11/02 (09/184,033) US

(54) **METHODE ET APPAREIL POUR TRANSFORMER DE GROSSES BALLES DE FOIN CARREES EN BALLES RECOMPRIMEES PLUS PETITES**

(54) **METHOD AND APPARATUS FOR PROCESSING LARGE SQUARE HAY BALES INTO SMALLER RECOMPRESSED BALES**



(57) A method and an apparatus for processing large hay bales of approximately 750 kg to produce smaller recompacted manageable units to facilitate shipping in containers. The method includes the steps of cutting the bales into at least two slabs, preferably three slabs, which are then cut in two approximately equal pieces. Each piece is recompressed, strapped and cut again to provide units having an approximate weight of 35 kg.

1427-3

METHOD AND APPARATUS FOR PROCESSING LARGE SQUARE HAY BALES INTO SMALLER RECOMPRESSED BALES

Field of Invention

This invention relates to compressed forage products, and in particular, to a method of processing large square bales of hay into smaller, recompressed bales.

Background of the Invention

There is a growing international market for recompressed hay, particularly in Japan and other Asian rim countries. Freight is one of the biggest costs in exporting hay overseas. Shipping is usually done in containers, which have a maximum weight limit. Freight is based on the number of containers, and so to minimize freight the container must be loaded to the maximum weight allowable. A typical hay bale, which consists of loose field hay which has been compressed once and strapped to form a bale, is too bulky to be transported overseas economically. Therefore, hay bales are commonly recompressed into smaller, denser bales before shipping.

Traditional recompression techniques were limited to small hay bales (approximately 35 to 40 kg; 16-18 in x 16 in x 48 in), e.g. U.S. Patent 5,249,350. However, balers which produce large square bales (approximately 750 kg; and with approximate dimension of 48 in x 52 in x 96 in), have become increasingly popular, due to the increased efficiency of bale production. In particular, large square bales cost less in materials and man hours to produce, and are more efficiently handled and transported across land to export packaging facilities. These

large square bales must be processed into smaller, denser bales before shipping, to reduce the costs of freight. It is also important that the bales be processed into smaller, more manageable units, because end users in Asian rim countries generally lack the necessary equipment to handle large, heavy bales. However, traditional recompression techniques are not capable of handling the immense size of large square bales. Accordingly, there is a need for a method of processing large square bales into a product that maximizes container weight, yet is light enough to be readily handled by the end user, without automated equipment.

Summary of the Invention

Accordingly, it is an object of the present invention to provide an improved method and apparatus for processing a large square hay bale into recompressed units.

This object is achieved by providing a method for processing a large square hay bale into recompressed units comprising the steps of: (a) making at least one cut through the bale to produce at least two slabs of approximately equal size; (b) separating the slabs; (c) recompressing the slabs in a compression chamber; and (d) removing the slabs from the compression chamber.

Conveniently, the bale has a plurality of binding straps, and the cut is made between at least two of the straps in a direction substantially parallel to the direction of the straps.

Conveniently, the cut is made by pushing the bale through at least on stationary horizontal knife using a hydraulically actuated plate.

Preferably, the slabs are separated by elevating the slabs using elevator means having a platform which is movable between a down position, wherein it receives the slabs of the bale, and an up position, wherein it is substantially level with a bale support, and pushing the slabs one at a time from the elevator means onto the bale support, using a moving means or pusher.

Conveniently, the separated slabs are moved along the bale support to a compression chamber, wherein the slabs may be compressed using a hydraulic compression ram.

In one embodiment, a selected amount of the slab is cut prior to introduction into the compression chamber. Conveniently, the selected amount may be determined by weight.

Preferably, a plurality of spaced apart straps are affixed to the recompressed units. In one embodiment of the present method, at least one cut is made through the recompressed unit after strapping to produce at least two smaller units of approximately equal size, wherein the cut(s) are made between the straps in a direction substantially parallel to the direction of the straps. Conveniently, the cut(s) are made by pushing the recompressed unit through at least one stationary vertical knife.

In one embodiment, the smaller units are lowered to the floor using a second elevator means, and pushing onto the floor using a moving means.

The invention also seeks to provide an apparatus for processing a large square hay bale into recompressed units, comprising in combination: a first cutting means for making at least one cut through the bale to produce at least two slabs of approximately

equal size; a separating means for separating the slabs, adjacent to the first cutting means; a bale support, adjacent to the separating means; a compression chamber for recompressing the slabs, adjacent to the bale support means; a first moving means for moving the slabs along the bale support means and into the compression chamber; a second moving means for moving the slabs out of the compression chamber.

An advantage of this method is that it efficiently processes a large square bale into smaller, denser bales, which are more cost-effective for overseas transport, and which may be more easily handled by end-users without automated equipment. A further advantage of this method is that it produces multiple recompressed bales with each cycle of the recompression chamber, which allows for greater efficiency of production. A still further advantage of this method is that it produces recompressed bales of uniform weight and good appearance.

Brief Description of the Drawings

A better understanding of the invention will be obtained by considering the detailed description below, with reference to the following drawings of embodiments of the present invention in which:

Figures 1A to 1E are perspective views showing the processing of a large square hay bale according to the steps of this invention.

Figure 1A illustrates the step of making two horizontal cuts in the large square bale, to create three horizontal slabs.

Figure 1B illustrates the step of making a vertical cut in the slab, to section off a unit having a desired weight.

Figure 1C illustrates the unit, before recompression.

Figure 1D illustrates the step of recompressing and strapping the unit.

Figure 1E illustrates the step of cutting the recompressed unit into the desired end products, having the desired weights.

Figures 2A to 2E are perspective views showing an alternative embodiment of the present invention, for processing a large square bale of different dimension than that illustrated in Figures 1A to 1E.

Figure 2A illustrates the step of making one horizontal cut in the large square bale, to create two horizontal slabs.

Figure 2B illustrates the step of making a vertical cut in the slab, to section off a unit having a desired weight.

Figure 2C illustrates the unit, before recompression.

Figure 2D illustrates the step of recompressing and strapping the unit.

Figure 2E illustrates the step of cutting the recompressed unit into the desired end products, having the desired weights.

Figure 3 is a top plan view of the apparatus.

Figure 4 is a side view of another section of the apparatus wherein a bale is forced against a stationary horizontal knife.

Figure 5 is a front view of a vertical knife for use in the apparatus.

Figure 6 is a schematic front view of an elevator; and

Figure 7 is a cross-sectional view of a compactor of the embodiment taken along the line 7-7 of Figure 3.

Detailed Description of the Invention

Referring to Figures 1A to 1E and 2A to 2E, a method for processing a large square hay bale 21 according to the present invention comprises the following steps. At least one horizontal cut 20 is made through the bale to produce slabs 22 of approximately equal size. A typical large square bale has a plurality of binding straps, and the cut 20 is made between straps in a direction substantially parallel to the direction of the straps. The slabs 22 are then separated from each other and moved along a bale support towards a compression chamber. A vertical cut 24 is made through a slab 22 to produce a unit 22a of a desired weight to fill the compression chamber. The unit 22a is compressed in the compression chamber to provide a compressed unit 26, removed from the compression chamber, and strapped using a plurality of straps 28 in a spaced apart relationship, such that a vertical cut 30 may be made between the straps 28 to produce an end product 32 of a desired weight.

It will be appreciated that the present method is suitable for large square bales of various sizes, and may also be used for processing smaller bales, with appropriate adjustments to the number of cuts. For example, in Figures 1A to 1E, a large square bale having the dimensions of 96 in x 52 in x 48 in, is processed by making two horizontal cuts 20 through the hay bale to produce

three slabs 22 of approximately equal size. A vertical cut 24 is made through a slab 22 to produce a unit 22a having a desired weight. After compression and strapping, two vertical cuts 30 are made through the compressed unit 26 to produce an end product 32 having approximate dimensions of 16 in x 17.5 in x 18 in.

In another embodiment, shown in Figures 2A to 2E, a large square bale having the dimensions of 96 in x 36 in x 36 in, is processed by making one horizontal cut 20 through the hay bale to produce two slabs 22 of approximately equal size. A vertical cut 24 is made through a slab 22 to produce a unit 22a of a desired weight to fill the compression chamber. After compression and strapping, one vertical cut 30 is made through the compressed unit 26 to produce an end product 32 having approximate dimensions of 16 in x 18 in x 18 in.

It will be appreciated that one may vary the weight of the end product 32 by adjusting the weight of the unit 22a used to fill the compression chamber and / or the number of vertical cuts 30 made to the compressed unit 26.

An apparatus for carrying out the method is shown generally at 90 in Figure 3 and includes a bale cutter shown at 100 in Figure 4.

As shown in Figure 4 a bale 21 is moved into contact with stationary knives 105. Knife attachment members 101 are secured as by welding to opposed side knife support members 103 adjacent one end of a bale bed 102.

Each of the knives 105 has a flat side 106, a bevelled side 107 and a cutting edge 108. The knives 105 are spaced apart to define three approximately equal compartments having a top edge

equipped with a pressure plate 115 secured to the side plates 103.

In an alternate embodiment, the cutting device may have only one horizontal knife or multiple horizontal knives.

A cylinder 109 mounted on a pivot 119 at an end of the bale bed 102 remote from the knives 105 has an inner end secured to the side of a ram head 132. The ram head 132 has upright transversely extending pusher plates 124, 125 and 126 secured thereto as by welding. Spaces 133 and 134 are provided at the ends of the plate 125, and are in alignment with the knives 105 and a space at the outer end of the plate 124 accommodates the pressure plate 115.

In operation, a bale 21 is placed on the bale bed 102 and the hydraulic cylinder 109 actuated thereby forcing a bale 21 against the cutting edge 108 of the knives 105. The upper side of the bale 21 contacts the pressure plate 115 to minimize deformation of the bale 21. The knives 105 can extend into the spaces 133 and 134 to complete the cutting of a bale 21 into three slabs 22 which are received on an elevator platform separating device 200. The elevator platform 200 (as shown more clearly in Figure 6) moves between a down position, where it is in alignment with the bale bed 102, and an up position, where it is in alignment with a bale support 202, and is indexed to stop as each of the slabs 22 is in alignment with the bale support 202. A pusher 204 is then activated as one of the slabs 22 is aligned with the bale support 202 and off loads an upper one of the slabs 22 onto the bale support 202. The pusher 204 moves upwardly and rearwardly before descending for the next cycle.

As shown in Figure 3, the bale support 202 is provided with vertical sides 205 and 206 to guide the slab 22. The bale support 202 has a right angle bend at 210 and a pusher 212, similar to pusher 204, engages an end of a slab 22 to move the slab towards a weigh station 220 and a second cutting knife 225.

Figure 5 shows a preferred embodiment of part of the invention 90 in which knife guide members 221 are attached, by welding or similar conventional means, to opposed sides 205 and 206 of the bale support 202. Cross member 223 is similarly attached to the upper ends 224 of the knife guide members 221. The knife 225 has a flat side (not shown) and a bevelled side 227 meeting at a cutting edge 228, and is mounted on cutting hydraulic cylinders 229 by means of clevises 230 so as to be slidably engaged in guide channels 231. Cutting channel 222 accommodates the knife cutting edge 228 when the knife 225 is in the lowered position.

Referring again to Figure 3, another pusher means 240, similar to the pusher 204, is preferably provided to move cut slab 22a in front of inlet opening 242 of the compression chamber 244. As shown more clearly in Figure 7 the compression chamber 244 is provided with guide means 250 hingedly attached at the compactor inlet 242. The guide means has a top wall 252 and two side walls 254 and 256. It will be appreciated that the guide means 250 is raised before the cut slab 22a is moved to the compression chamber 244. When the cut slab 22a is in position, the guide means 250 is lowered and a rectangular ram provided with suitable hydraulic means 258 is adapted to move the cut slab 22a into the compression chamber 244. The major portion of the compaction or compression is provided by a hydraulically operated ram 264 which moves parallel to the table 202. A compressed unit 26 is ejected by an ejection ram 270 and is positioned in a banding or

strapping station. The bale strapping machine 274 moves along the length of the recompressed unit 26 providing straps 28 at the required intervals. The recompressed unit 26 is not capable of being easily handled without machinery and therefor further subdividing of the recompressed unit 26 is carried out in the cutter box 280. A ramp may be sloped downwardly from the strapping machine 274 to the cutter box 280 to feed the recompressed units 26 into the cutter box 280. The cutter box 280 is positioned to receive recompressed units 26 leaving the strapping station 274 and has walls 284 to guide the recompressed units 26 as hydraulic rams 290 move the bale slab through at least one vertical knife which divides the recompressed unit 26 into smaller units 32 of approximately equal size. In a preferred embodiment, the cutter box 280 contains two vertical knives. The vertical cuts are made between the straps in a direction substantially parallel to the direction of the straps. A second elevator receives the smaller units 32 after they pass through vertical knives, and lowers them to the ground, where a moving device pushes the smaller units 32 from the second elevator onto the ground.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Apparatus for processing a large square hay bale into recompressed units, comprising in combination:

a first cutting means for making at least one cut through the bale to produce at least two slabs of approximately equal size;

a separating means for separating the slabs, adjacent to said first cutting means;

a bale support means, adjacent to said separating means;

a compression chamber for recompressing the slabs, adjacent to said bale support means;

a first moving means for moving the slabs along the bale support means and into the compression chamber, wherein the slabs may be compressed to form recompressed units;

a second moving means for moving the recompressed units out of the compression chamber.

2. An apparatus according to claim 1 wherein the bale has a plurality of binding straps, and said at least one cut is made between the straps in a direction substantially parallel to the direction of the straps.

3. An apparatus according to claim 1 wherein said first cutting means consists of:
a bale bed of sufficient size to accommodate the hay bale, having a cutting end which is adjacent to said separating means;

at least one stationary horizontal knife, situated at the cutting end of the bale bed, and spaced apart from the platform so as to create slabs of approximately equal size;

means for supporting said at least one stationary horizontal knife;

a third moving means for pushing the bale through said at least one stationary horizontal knife, to produce said slabs.

4. An apparatus according to claim 3 wherein said means for supporting said at least one horizontal knife comprises opposed knife support members, which are generally perpendicular to the plane of the platform, and which are affixed on opposed sides of the bale bed at the cutting end; and wherein said at least one horizontal knife is affixed between said knife support members.

5. An apparatus according to claim 3 wherein said third ram moving means consists of an hydraulically actuated plate which is generally perpendicular to the plane of the platform.

6. An apparatus according to claim 1 wherein said separating means comprises:

an elevator means for receiving and elevating said slabs, said elevator means having a platform which is movable between a down position, wherein it receives the slabs of the bale, and an up position, wherein it is substantially level with the bale support means;

a fourth moving means for pushing the slabs one at a time from said elevator means onto said bale support means.

7. An apparatus according to claim 6 wherein said elevator means moves upwardly in increments which are substantially equal to the height of one slab.

8. An apparatus according to claims 6 or 7, further comprising computer means for activating said fourth moving means when said elevator means is at an appropriate height to transfer said slab onto said bale support means.

9. An apparatus according to claim 1 wherein said bale support means consists of a platform with side walls, wherein the platform is of a sufficient width to accommodate the slabs.

10. An apparatus according to claim 1 wherein said compression chamber is defined by a bottom, and 4 side walls;

an inlet opening in one side wall, facing said bale support means,

an outlet opening in an other side wall; and

a hydraulic ram at a side wall for moving slabs or portions thereof into the compression chamber.

11. An apparatus according to claim 1, further comprising:

a second cutting means located on the bale support means for severing a selected amount of the slab to be introduced into the compression chamber.

12. An apparatus according to claim 11 wherein said second cutting means comprises:

knife guide members affixed on opposing sides of the bale support means, which are generally perpendicular to the plane of the bale support means;

a blade, having a flat side and a bevelled side which meet at a cutting edge, the blade being slidably mounted on the knife guide members, with the cutting edge pointing towards the bale support means; and

means to move the blade through the slab to meet the bale support means.

13. An apparatus according to claim 12 wherein the means to move the blade is at least one hydraulic cylinder.

14. An apparatus according to claim 11 further comprising weighing means located between said second cutting means and said compression chamber, for weighing a selected amount of the slab to be introduced into the compression chamber.

15. An apparatus according to claim 14 further comprising computer means for actuating said second cutting means when

said selected amount has been introduced into said weighing means.

16. An apparatus according to claim 1 further comprising a strapping means for affixing a plurality of spaced apart straps onto the recompressed units.

17. An apparatus according to claim 16 further comprising a third cutting means for making at least one cut through said recompressed units after strapping to produce at least two smaller units of approximately equal size, wherein said at least one cut is made been the straps in a direction substantially parallel to the direction of the straps.

18. An apparatus according to claim 17 wherein said third cutting means comprises:

at least one stationary vertical knife; and

a fifth moving means for pushing the recompressed unit through said at least one stationary vertical knife, to produce said smaller units.

19. An apparatus according to claim 18 wherein said fifth moving means consists of an hydraulically actuated plate which is generally perpendicular to the plane of the platform.

20. An apparatus according to claim 17 further comprising a ramp between said strapping means and said third cutting means, wherein said ramp is sloped downwardly toward said third cutting means.

21. An apparatus according to claim 17 further comprising a second elevator means for receiving said smaller units after they pass through said third cutting means, and for lowering said smaller units to the ground.

22. An apparatus according to claim 21 further comprising a sixth moving means for pushing said smaller units away from said second elevator means, when said second elevator means is lowered to the ground.

23. Method of processing a large square hay bale, into recompressed units comprising the steps of:

(a) making at least one cut through said bale to produce at least two slabs of approximately equal size;

(b) separating said slabs;

(c) recompressing said slabs in a compression chamber; and

(d) removing said slabs from the compression chamber.

24. A method according to claim 23, wherein the bale has a plurality of binding straps, and wherein in step (a) the cut is made between at least two of straps in a direction substantially parallel to the direction of the straps.

25. A method according to claim 24, wherein in step (a) said cut is made by pushing the bale through at least one stationary horizontal knife.

26. A method according to claim 25, wherein in step (a) said bale is pushed through at least one stationary horizontal knife using a hydraulically actuated plate.

27. A method according to claim 23, wherein step (b) comprises the steps of:

elevating the slabs using elevator means having a platform which is movable between a down position, wherein it receives the slabs of the bale, and an up position, wherein it is substantially level with a bale support means, and

pushing the slabs one a time from the elevator means onto the bale support means, using a moving means.

28. A method according to claim 27, further comprising, between steps (b) and (c), the step of moving said slabs along said bale support means to said compression chamber.

29. A method according to claim 23, wherein step (c) further comprises the use of a hydraulic compression ram to compress said slabs.

30. A method according to claim 23, further comprising, between steps (b) and (c), the step of cutting a selected amount of the slab to be introduced in the compression chamber.

31. A method according to claim 30, further comprising the step of determining the selected amount by weight, before cutting said selected amount.

32. A method according to claim 23, further comprising the step of:

(e) affixing a plurality of spaced apart straps to said recompressed units.

33. A method according to claim 32, further comprising the step of:

(f) making at least one cut through said recompressed unit to produce at least two smaller units of approximately equal size, wherein said at least one cut is made between the straps in a direction substantially parallel to the direction of the straps.

34. A method according to claim 33, wherein in step (f) said at least one cut is made by pushing the recompressed unit through at least one stationary vertical knife.

35. A method according to claim 33 further comprising the steps of:

(g) lowering the smaller units to the floor using a second elevator means; and

(h) pushing the smaller units onto the floor using a moving means.

ABSTRACT

A method and an apparatus for processing large hay bales of approximately 750 kg to produce smaller recompacted manageable units to facilitate shipping in containers. The method includes the steps of cutting the bales into at least two slabs, preferably three slabs, which are then cut in two approximately equal pieces. Each piece is recompressed, strapped and cut again to provide units having an approximate weight of 35 kg.

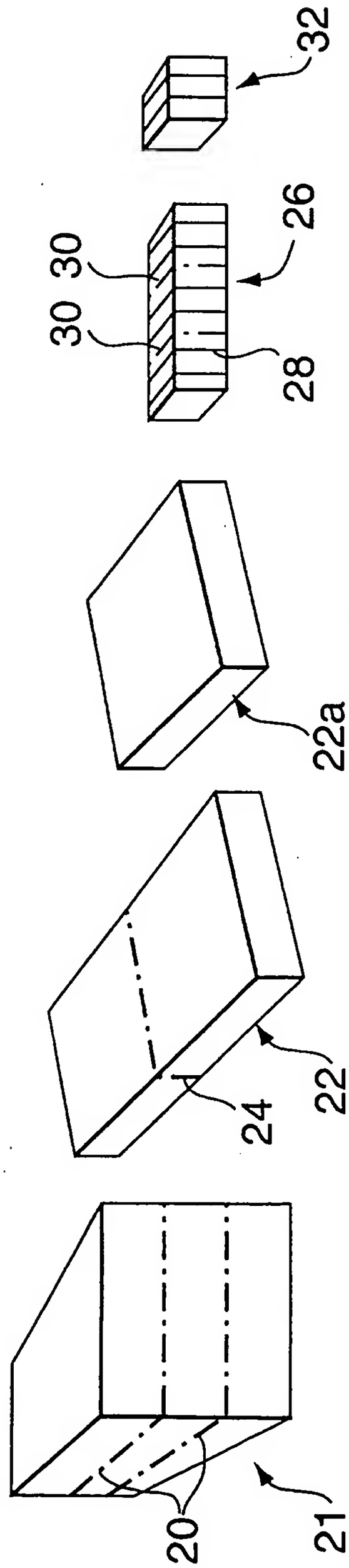


FIG. 1A FIG. 1B FIG. 1C FIG. 1D FIG. 1E

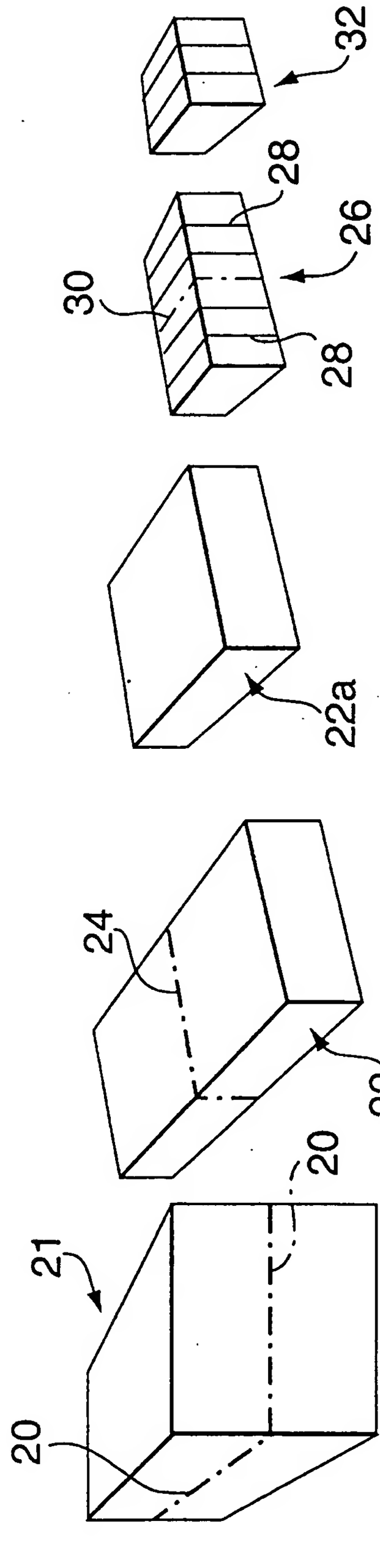


FIG. 2A FIG. 2B FIG. 2C FIG. 2D FIG. 2E

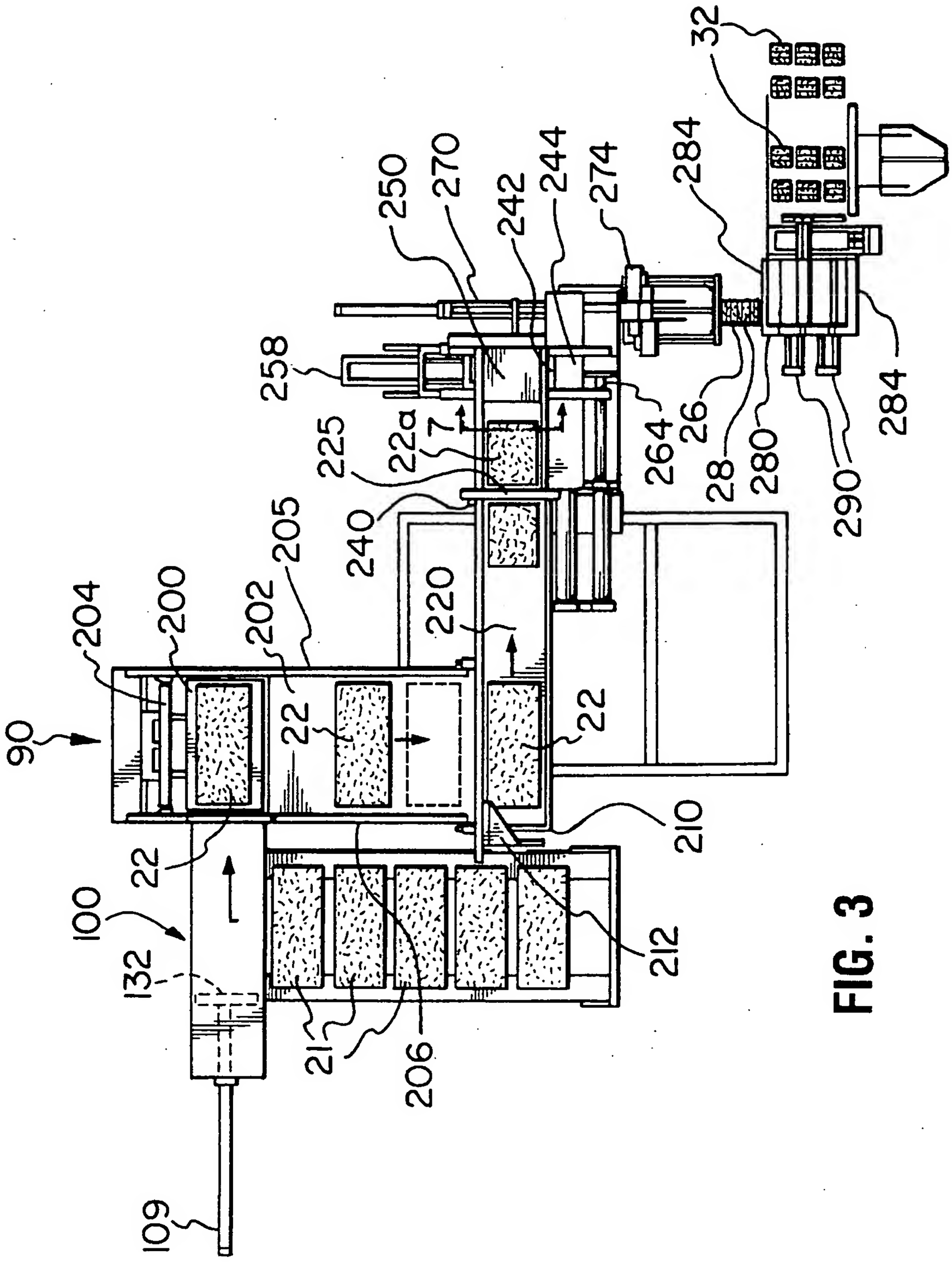

32
284
250
270
242
244
274
258
225
22a
7
240
205
202
200
204
220
90
22
100
132
212
210
264
26
28
280
290
284
21
206
109

FIG. 3

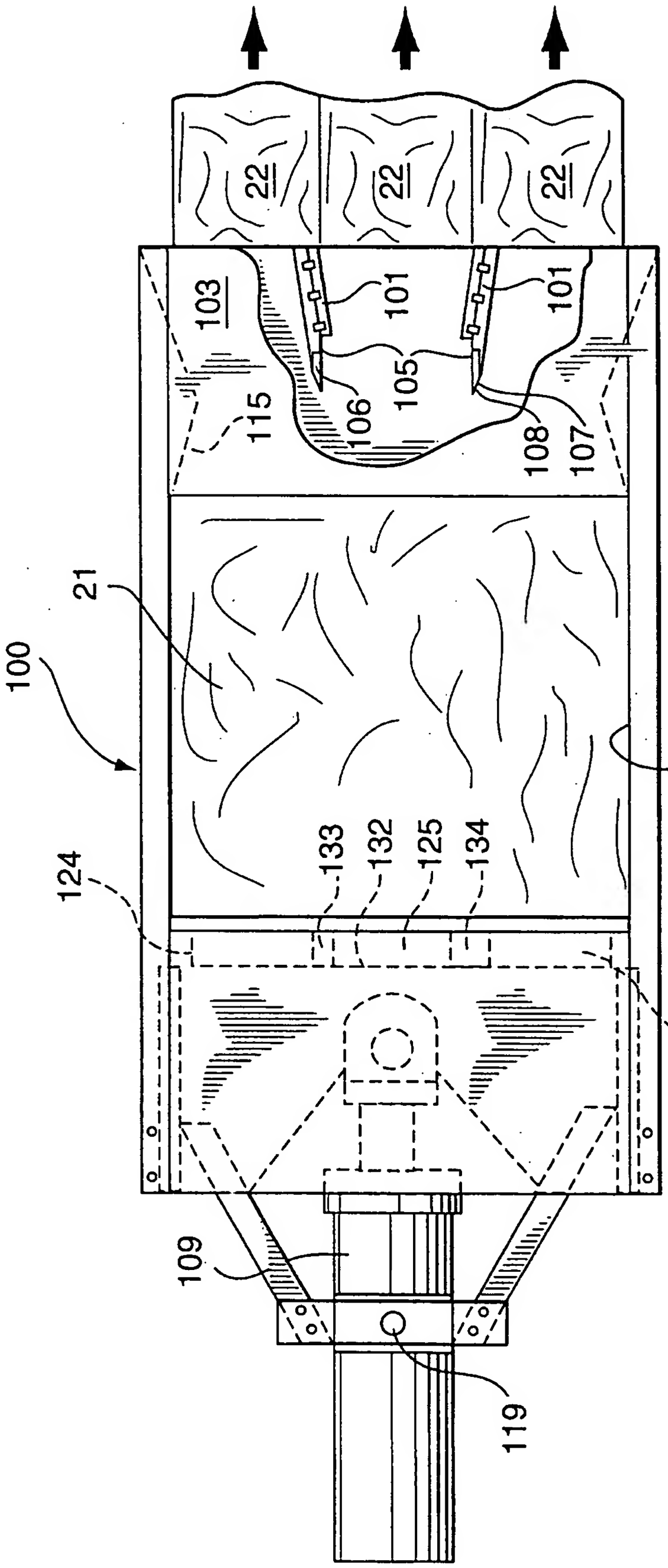

22
22
22
103
101
101
105
115
106
108
107
21
100
102
124
133
132
125
134
126
109
119

FIG. 4

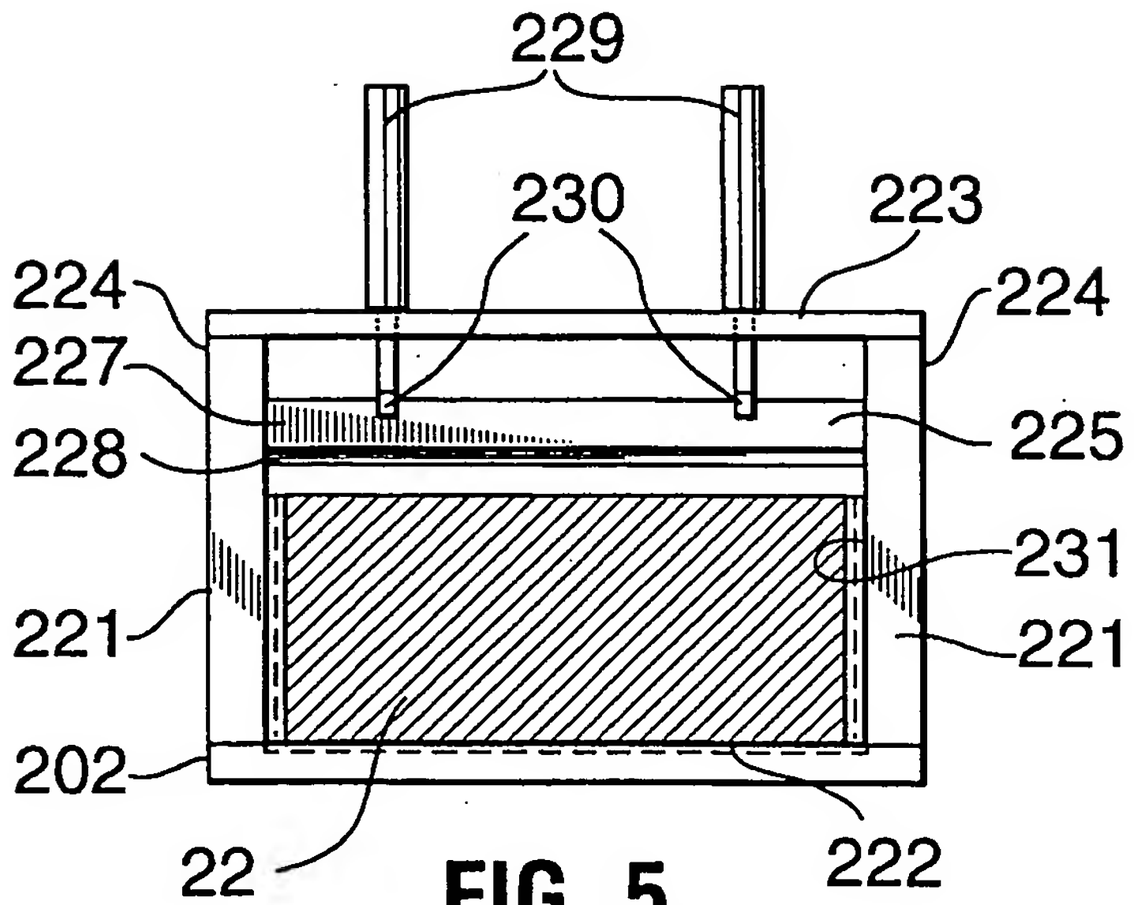


FIG. 5

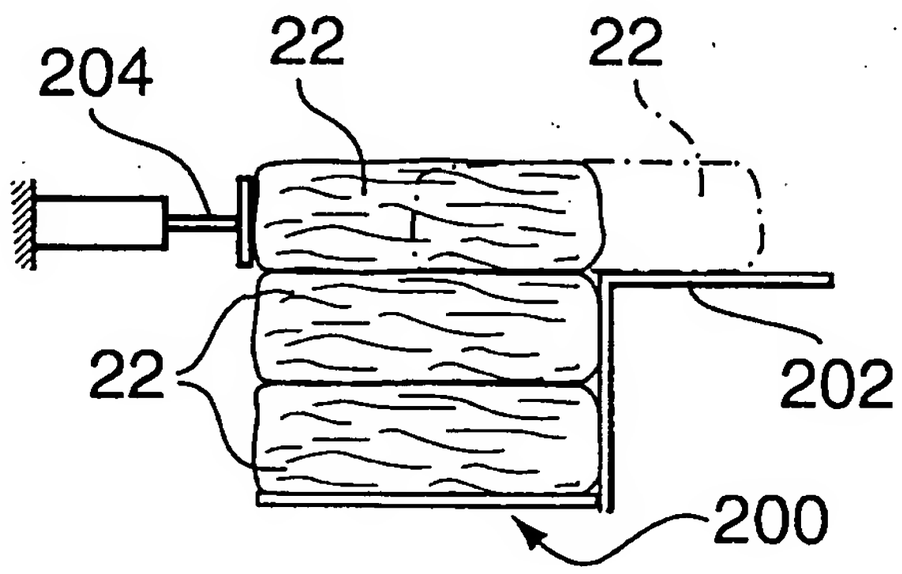


FIG. 6

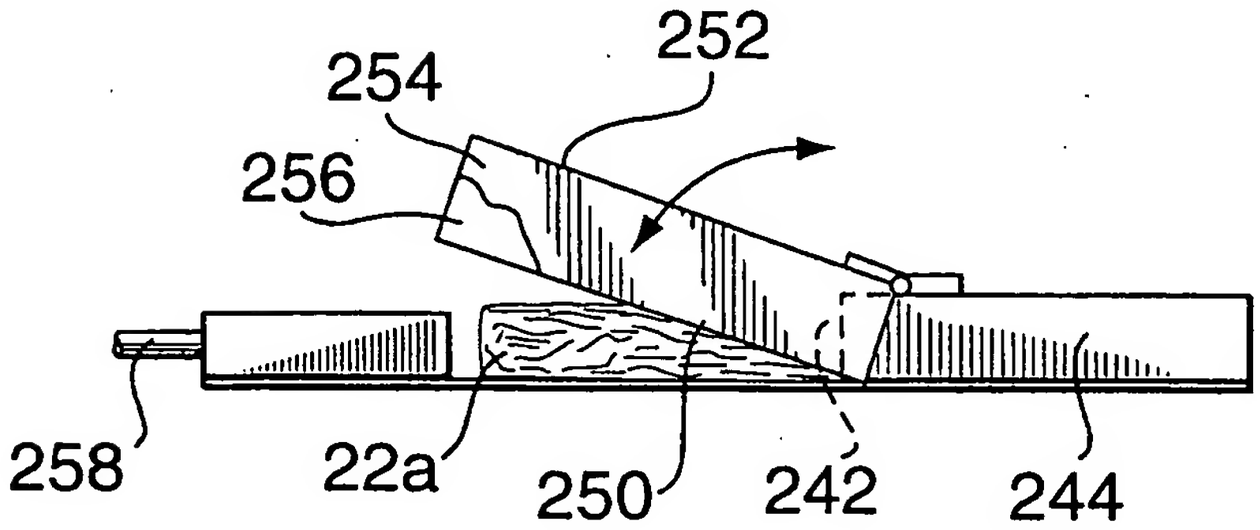
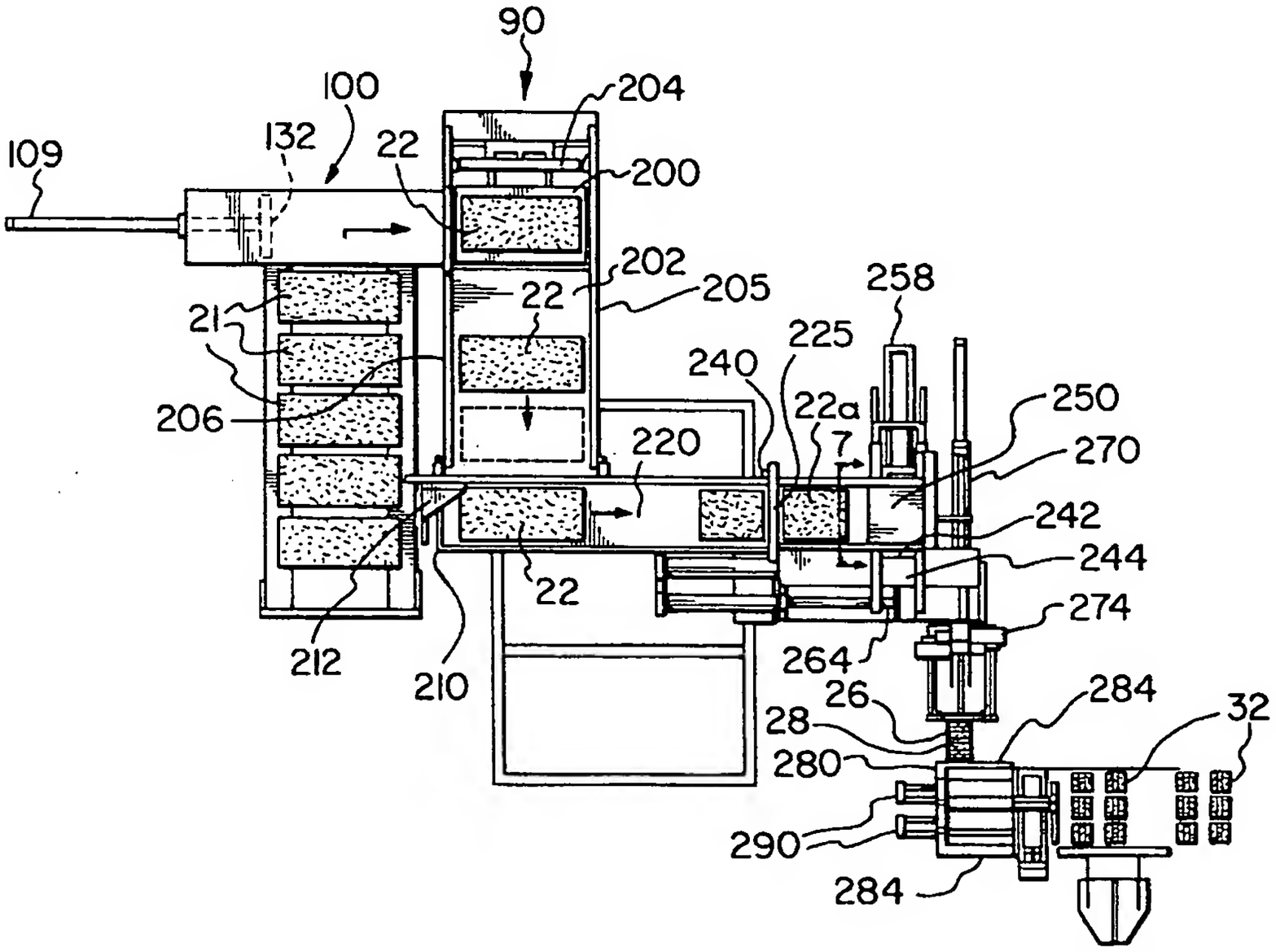


FIG. 7


90
100
132
109
22
204
200
202
205
22
21
206
212
210
22
220
240
225
22a
7
258
250
270
242
244
274
264
26
28
280
290
284
284
32